NIAB TAG

Agronomy Strategy 4

2019

Spring Strategies

Cereals and break crops: fungicide strategies

niab.com

Strategies 1:

Winter oilseed rape establishment, seed rates, seed treatments, sowing dates, weed control, disease control, autumn pest control.

Winter cereals: seed rates, sowing dates, seed treatments.

Stubble cultivations for grass weed control.

Strategies 2:

Winter cereals: autumn weed control, autumn pest control.

Winter beans: establishment, seed rates, weed control.

Strategies 3:

Nitrogen, sulphur, growth regulators, spring weed control in cereals and break crops.

Strategies 4:

Cereals and break crops: fungicide strategies.

This edition published February 2019

A charitable company limited by guarantee

Designed and produced by Cambridge Marketing Limited, 01638 724100

Agronomy Strategy 4 2019

Contents

Introduction

This booklet presents our Strategies for disease control in spring 2019 for the main combinable crops, put together by NIAB TAG staff from our latest trial results.

For winter wheat we have continued with a suggested range of fungicide expenditure according to disease risk, itself determined by a range of factors which we encourage members to assess. We have increased the significance of factors such as sowing date and variety choice in this, as these cultural control measures grow in importance. For the winter barley crop we have continued our guidance towards three-spray programmes.

Any changes in the Strategies, due to crop growth and disease pressure issues as they develop, will be addressed in the Agronomy Updates as we progress through the 2019 spring. As ever, you are encouraged to discuss appropriate programmes with your Regional Agronomist, and Agronomy Local members can discuss them more widely at the Field Days during the season.

NIAB TAG Regional Agronomy team.

1. Winter wheat

Fungicide programmes – overview

Eradicant fungicide activity continues to slip as more resistant Septoria isolates develop, hence the emphasis of our control programmes is preventative disease control. Protectant activity remains good but requires well-timed applications. We also need careful fungicide stewardship to try to prevent further selection of more resistant isolates. Fortunately there has also been a shift to wheat varieties with better disease resistance, which will help reduce disease pressure and slow the development of resistance.

Every year has different levels of disease pressure, often with different diseases being prominent. In 2014/15 there was moderate disease pressure from both *Septoria tritici* and yellow rust, whereas 2015/16 had very variable septoria and yellow rust levels across the country. 2016/17 had lower Septoria pressure due to a dry winter and very dry spring but yellow rust pressure was higher as was that from brown rust later in the season. 2017/18 had mainly low disease pressure in a season with a long, open autumn; a cold, wet winter; a short late, wet spring and a long, dry, very hot summer.

Crops have been sown over a wide range of sowing dates this autumn and this has resulted in differing levels of disease in the crops at this stage. In the September sowings it is easy to find Septoria, yellow and brown rust and mildew present and active. Later sowing dates should result in less disease pressure but the mild and wet December will allow some disease build up in these crops. However, we cannot be certain what level of disease pressure we will face by the time we need to make decisions on what to apply, so please follow our Agronomy Updates as these will modify guidance as the season progresses.

Disease pressure scoring system

We have refined our disease pressure scoring system to determine the likely appropriate level of fungicide expenditure that will be required. The score is based on the many factors which determine disease build up, combined with some growers' attitudes, to allow some detailed guidance to help members decide the appropriate fungicide spend and then a possible programme. There are a few tweaks again this year to better define fungicide programmes but as always there may need to be some adjustments if disease pressure changes through the season. The appropriate spend is guided by Bill Clark's Margin over Fungicide Input Model.

The factors considered in the disease pressure scores are:

1) Variety disease resistance ratings and known response to fungicides.

2) Sowing date – later sowing has a profound influence on disease pressure.

3) Geographic location – for example lower input septoria treatments would be more appropriate for the east compared to the west/south west under almost any circumstances.

4) The weather – generally it is the weather condition after a spray that dictates the level of subsequent input required, but warm wet weather prior to treatment will build disease pressure. At this stage, we can only look at what has happened as that will indicate the disease inoculum levels for the start of the season. For the purposes of the disease pressure score, this has been split into winter and early spring periods.

5) Sprayer capacity – to be able to apply sprays promptly and minimise the chance of an interruption due to weather.

6) Growers' attitude to risk – some growers will wish to have a more robust approach just in case, for example, the weather changes.

Scores for each section should be added together to achieve an overall score which may then be matched to the appropriate fungicide programmes.

However, since the risk is to margin, we should stress that our recent studies on the economics of wheat disease control have shown that margin loss from spending too little in a high disease year is roughly three times the margin loss from spending too much in a low disease year, irrespective of variety.

1) **Variety** – Yield response to fungicide treatments.

   This is partly related to the disease resistance score but there are some varieties whose ratings would suggest they should be more yield responsive to fungicides than they are and equally some with good resistance that still produce high yield responses to fungicides. We have therefore worked on the yield response to fungicide rather than disease resistance ratings.

Yield Response to fungicide	Varieties	Disease pressure score
Very Low	KWS Extase	0
Low	Dunston, Graham, KWS Zyatt, Moulton, LG Motown, LG Sundance, RGT Illustrious, KWS Firefly	2
Moderate	Bennington, Costello, Elicit, Freiston, Gleam, KWS Crispin, KWS Siskin, Revelation, Skyfall	4
High	Crusoe, Evolution, KWS Kerrin, KWS Silverstone, KWS Trinity, LG Skyscraper, LG Spotlight, Shabras	6
Very High	Claire, Dickens, Elation, Grafton, JB Diego, KWS Basset, KWS Jackal, KWS Lili, LG Detroit, RGT Gravity, Savello, Viscount, Zulu	8
Extremely High	Cordiale, Gallant, KWS Barrel, Leeds, LG Jigsaw, LG Interstellar, LG Rhythm, LG Sabertooth, Myriad, Reflection, KWS Santiago, SY Loki	10

Table of yield response – based on Recommended List

	Variety	Yield response t/ha
Very Low	KWS Extase	0.69
Low	RGT Illustrious	1.61
	Graham	1.61
	KWS Zyatt	1.62
	Dunston	1.64
	LG Sundance	1.75
	LG Motown	1.78
	KWS Firefly	1.82
Moderate	KWS Siskin	1.89
	KWS Crispin	1.97
	Revelation	1.97
	Bennington	1.99
	Costello	2.01
	Skyfall	2.04
	Gleam	2.10
	Elicit	2.10
High	Evolution	2.29
	LG Spotlight	2.38
	Shabras	2.39
	KWS Trinity	2.39
	LG Skyscraper	2.49
	KWS Kerrin	2.51
	Crusoe	2.54
Very High	Elation	2.62
	LG Detroit	2.63
	RGT Gravity	2.73
	KWS Basset	2.86
	KWS Jackal	2.87
	Zulu	2.92
	KWS Lili	3.16
	JB Diego	3.19
Extremely High	KWS Barrel	3.26
	Leeds	3.45
	Myriad	3.85

2) **Location** – This is the local disease pressure for your area based on septoria risk.

Area of the country	Disease pressure score
East	1
North	2
South East	2
West	3
South	3
South West	4

There are too many counties to include every single one in the table, so members should choose the appropriate region to match their likely rainfall and disease pressure.

3) **Sowing date** – The earlier a crop is sown the greater the disease infection it will be exposed to and the larger the amount of inoculum plants will be carrying into the spring. Autumn 2018 did allow later sowings but many farms started earlier and there is a visible difference in the level of disease in crops sown at different times with the later crops carrying much less disease.

Sowing period	Disease pressure score
Early September	10
Mid-September	8
Late September	7
Early October	5
Mid-October	3
Late October	2
November onwards	0

4) **Weather** – This has been split into two periods, winter and early spring. If both periods are wet and mild then the disease infection levels will be higher. The winter period is November and December and Early Spring is January to March.

	Disease pressure score
Wet Mild Winter	2
Dry Cool Winter	0
Wet Mild Early Spring	4
Dry Mild Early Spring	2
Dry Cool Early Spring	0

5) **Sprayer capacity** – If a farm has the capacity to spray all their wheat crops in a shorter period then it may not need as robust a programme as one that requires several days to cover all the wheat area. Therefore, an appropriate score can be added.

Sprayer capacity	Disease pressure score
All Wheat in 1 day	0
All wheat in 2-3 days	1
4 days or more	3

6) **Attitude to risk** – If a farm has tendency to err on the side of caution then the score should be increased, as the grower would prefer a more robust programme. As already mentioned, there is a three times greater penalty to margin for spending too little when disease pressure turns out to be high than the same overall spend when disease pressure is lower; so members may wish to be cautious.

Those members wishing to take a more cautious approach should **add 2** to the final score.

Equally, there could be growers who are willing to take a risk, or feel a lower cost programme will be more appropriate, in which case they could **subtract 1** (or 2) from the final score.

Final disease pressure score	Appropriate fungicide programme spend	Suggestions
Up to 12 (Low)	£60-£80/ha	Leaf 4 – No T0 unless active rust Leaf 3 (T1) – Azole + Chlorothalonil (CTL) Flag Leaf (T2) – Appropriate dose SDHI + azole + CTL Ear (T3) – tebuconazole
13-15 (Moderate)	£80-£100/ha	Leaf 4 (T0) – No T0 or CTL (+ azole if rust) Leaf 3 (T1) – Appropriate dose SDHI + azole + CTL Flag Leaf (T2) – SDHI + azole + CTL Ear – T3 tebuconazole
16-18 (High)	£100-£115/ha	Leaf 4 (T0) – CTL (+ azole if rust) Leaf 3 (T1) – SDHI + azole + CTL Leaf 2 (T1.5) – CTL ± azole if necessary Flag Leaf (T2) – SDHI + azole + CTL Ear (T3) – Appropriate azole ± Strobilurin
Over 18 (Very high)	£115-£130/ha	As above but more robust product choices or higher doses and could add a pre-leaf 4 (pre-T0) if required

Fungicide programmes

Pre-Leaf 4 (pre-T0): Pre GS30 – February/Early March

This spray would rarely be beneficial. The only possible reason for a spray at this stage would be early control of severe early yellow rust infections; as seen over winter in 2015/2016. You should expect to see no yield benefit from this spray in the great majority of scenarios. A suggested treatment would be tebuconazole 50% dose.

Leaf 4: (T0) GS30-31 (mid-March-early April):

Chlorothalonil 500 g/ha (e.g. Bravo 1.0 l/ha):

Add:

(i) A strobilurin if rust is not present (check carefully) but expected (due to variety susceptibility)
e.g. + Comet 0.3 l/ha *or* Amistar Opti 1.0 l/ha to deliver both

(ii) an azole if rust is present
e.g. tebuconazole (e.g. **Folicur** 0.5 l/ha, **Toledo** 0.3 l/ha)
or **Crafter/Confucius** 1.5 l/ha *or* **Alto Elite** 1.0-1.5 l/ha (top up CTL if lower dose used)

(Other azole/CTL formulations are available).

- Leaf 4 (T0) sprays are essential to yellow rust programmes, whilst for septoria the leaf 4 spray is mainly an insurance against a delayed leaf 3 (T1) treatment. Omitting the leaf 4 spray could demand more eradicant activity from the next treatment. But also, on the most resistant varieties it is unlikely to produce any yield response.
- Although important in yellow rust control, we must aim to moderate use of azole fungicides due to their declining efficacy against septoria, so reduce the exposure of the disease to this chemistry where possible. Azoles still have some activity, particularly protectant, against septoria and it is in our interests to maintain this if we can.
- Hence, if rust, present or expected, is not a target of the leaf 4 spray, azoles need not be used. Septoria can be adequately addressed at this timing with chlorothalonil alone, whilst an additional strobilurin will give protection against rust. Azoles should only be included to eradicate rust infection already in the crop.
- Later sown crops (November-December) move through development stages, and hence fungicide timings, more quickly and would suffer less from the omission of a leaf 4 spray. Such crops should not therefore be treated routinely, but in response to developing disease needing prompt treatment. This includes **mildew**, to which these crops can be particularly susceptible; or if these crops show signs of yellow rust infection in the spring.
- If there is no significant disease pressure at the time, Leaf 4 timing is not critical and is usually between two and four weeks before the Leaf 3 spray and can often be tank mixed with early PGRs or herbicides.
- Do not tank mix any chlorothalonil product (e.g. Bravo) with Atlantis as the performance of the latter may be affected. In such cases, if only targeting rusts, a low dose azole will suffice, though again some effect on the herbicide performance may result.
- If mildew is present or threatens in high risk situations apply **Talius**, 0.125 l/ha, or **Cyflamid** 0.15-0.2 l/ha, or **Fielder SE** 1.0 l/ha (equivalent to Talius 0.125 l/ha + 500 g CTL) alone or mixed with above treatments as required. A low-dose morpholine (e.g. fenpropimorph 250 g a.i./ha) is another option if mildew is established.
- **Take-all** – If take-all is a particular threat i.e. second or third wheat early sown (before October 10th) with no Latitude seed dressing, consider **Amistar Opti** 1.5 l/ha or **Fandango** 1.5 l/ha + CTL as the leaf 4 (T0) application.

Leaf 3 (T1):

- **Extremely high/very high disease pressure score:**

  Aviator 1.25 l/ha *or* **Adexar (***or* **Librax) 1.25 l/ha**

  ***ALL* + CTL 500g/ha**

- **High/moderate disease pressure score:**

  Adexar/Librax 1.0 l/ha, Aviator 1.0 l/ha, Vertisan 1.0 l/ha + Azole

  or **Keystone 0.8 l/ha**

  or **Tracker 1.0 l/ha**

  ***ALL* + CTL 500g/ha**

- **Low/moderate disease pressure score:**

  Aviator 0.8 l/ha + CTL

  or **Tracker 1.0 l/ha + CTL**

  or **epoxiconazole 60-90 g/ha/ Proline 275 0.45-0.55 l/ha + CTL 500 g/ha**

Choose the option above that will give the appropriate cost for your total fungicide programme as determined by your disease pressure score shown previously.

Eyespot

The addition of **Tracker** or inclusion of prothioconazole (e.g. in **Proline** or **Aviator**) in the product choice would be favoured if there is an eyespot risk.

If eyespot is developing in extreme/very high/high disease pressure score situations, then consider:

Adexar/Librax 0.75 l/ha + Tracker 0.75-1.0 l/ha + CTL 500 g/ha

- Where there is a risk of **mildew**, again consider adding **Talius**, or **Cyflamid** if they were not applied at Leaf 4 (T0). Note: that some newer varieties have a low mildew resistance rating (LG Detroit, KWS Firefly, RGT Gravity, KWS Basset, Skyfall, Myriad, Dunston, and Revelation) along with older varieties such as Claire, Solstice, Leeds, KWS Kielder.
- For additional rust protection at T1, a low dose of strobilurin can be added (e.g. **Comet** 0.3 l/ha, or **Amistar Opti**, the latter delivering chlorothalonil), to any of the above.
- **Timing**: T1 timing is critical to yield and should be applied when at least two thirds of leaf 3 has emerged on the main shoot. At this stage it will be starting to unroll and present a surface to treat. Delaying much beyond this risks allowing infection on this leaf to develop and manifest after treatment is applied. In most cases this stage occurs at late GS31-early GS32.
- **Later sown crops** tend to produce fewer leaves hence leaf 3 can often be the one emerging at GS31 or earlier. These crops will need careful checking for leaf emergence. They will carry less infection/less inoculum since older leaves have been exposed for less time and at lower temperatures. Hence they should always be easier to keep clean.
- Formulations equivalent to **Vertisan** plus chlorothalonil are available (**Aylora**, **Treoris**), only needing a azole partner to use as above.
- Azole dose in mix with all SDHIs should be a minimum 50% dose preferably 75%, ideally of epoxiconazole or prothioconazole.

Leaf 2 (T1.5) – GS33-37:

Treating each leaf as it emerges, though difficult, is the best approach in high disease pressure situations and with less eradicant activity available in the current fungicide options we may have to adopt this approach. Hence this leaf 2 timing is important if septoria pressure in particular has been high, following a mild wet spring and where there is a long time gap (greater than three weeks) between leaf 3 (T1) and flag leaf (T2) timings.

For example, in 2015/16, many crops treated at T1 before 25 April, could have benefited from a T1.5 prior to the T2 around 15-20 May.

Again, to minimize azole use, **chlorothalonil** alone should be used, assuming other sprays have been timely, since this spray is required to provide only short-term protection. This treatment should also be considered where with the benefit of hindsight, a lower dose SDHI was used at T1 than was appropriate.

- In high disease pressure situations we may be moving to more fungicide spray timings and 4-5 applications may become the norm. As fungicide performance in general declines products will have to be used at higher doses and in more protectant strategies, which would include this pre-flag leaf (Leaf 2) spray timing.
- Members applying a late season growth regulator or herbicide are likely to go through the crop at this timing anyway, so this may not necessarily involve an extra pass.
- An interim spray between the leaf 3 and flag leaf spray will be needed under the following circumstances:
    - High septoria pressure (wet April/early May)
    - High early season disease pressure and/or an early or no leaf 4 (T0) spray leading to a leaf 3 spray timed well before leaf 3 was fully out. This could then lead to a wide leaf 3 to leaf 1 window leaving leaf 2 exposed to infection (later sown crops will move through development stages more quickly so an extended leaf 3 to flag leaf period is less likely).
    - Where **yellow rust** is targeted, this timing may be necessary to maintain protection against this disease, control of which is less tied to leaf emergence, and more to the timing of and persistence of the previous fungicide. In these circumstances a strobilurin can be added to the chlorothalonil for rust protection, or a azole for rust eradication, as with the leaf 4 (T0) options.
    - Where **tan spot** is obvious in the lower canopy.
- Even in the above situations, a leaf 2 spray may not be needed where a robust dose of SDHI was applied to leaf 3, at a time when leaf 2 was emerging, or where a very dry or very cold spring has significantly suppressed septoria pressure.

Flag leaf (T2) – GS39 (37-45):

- **Extremely high disease pressure score:**
  Ascra 1.25-1.5 l/ha
  or **Adexar/Librax 1.25-1.5 l/ha**
  or **Elatus Era 1.0 l/ha**
  ***ALL* with CTL 500 g/ha**

- **High disease pressure score:**
  Ascra 1.25 l/ha
  or **Adexar/Librax 1.25-1.0 l/ha**
  or **Elatus Era 0.8-1.0 l/ha**
  ***ALL* with CTL 500 g/ha**

- **Moderate disease pressure score:**
  Adexar/Librax 1.0 l/ha
  or **Elatus Era 0.8 l/ha**
  or **Aviator 1.0-1.25 l/ha**
  or **Ascra 1.0-1.25 l/ha**
  ***ALL* with CTL 500 g/ha *except* Aviator**

- **Low disease pressure score:**
  Aviator 1.0 l/ha
  or **Adexar/Librax 0.8 l/ha**
  or **Keystone/Seguris 1.0 l/ha**
  or **Vertisan 1.0 l/ha + azole**
  ***ALL* with CTL 500 g/ha *except* Aviator**

- By flag leaf emergence there should be more confidence in decisions and the actual level of risk to which the crop is exposed. A wet spring, varieties with any disease ratings below 6, timing of earlier sprays and any crop in the west, would all push thinking towards the high pressure situation above, whereas a dry spring, resistant variety, and a punctual programme to date, might allow consideration of moderate or low disease pressure options.
- In recent years resistance to the azole fungicides has continued to progress and SDHI products are now essential to keep on top of septoria. Recent trials have continued to show the value of CTL against septoria, hence it is recommended for inclusion in almost all sprays and timings discussed here.
- The inclusion of CTL at flag leaf is likely to give a positive response in most cases. However CTL may be detrimental in an extreme eradicant situation, i.e. where sprays have been significantly delayed (to, say, ear emergence) and target leaves are likely to be already infected but symptoms not yet visible. In such cases CTL could be left out of the spray and the cost of the CTL invested in extra SDHI dose. This effect is more pronounced in mixes with Aviator so the inclusion of CTL is not recommended for this product.
- In several recent AHDB Fungicide Performance trials Vertisan (penthiopyrad) has given noticeably lower yields than other SDHI products. Although in these trials, products are only applied once and disease pressure is very high, this does support other concerns about the product's persistence. If Vertisan is used at flag leaf it would need a timely routine ear spray. Azole dose in mix with Vertisan should be a minimum 50% dose, preferably 75%, ideally of prothioconazole or epoxiconazole.

- Where a range of doses is suggested, it would be advisable to purchase sufficient for the higher dose, and if not needed then any excess can be saved for next season.
- Where under extreme septoria pressure, the dose of SDHI in terms of grams of active ingredient per ha was seen to have a positive effect in recent trials work, this reinforces the need to keep doses up where septoria pressure is high and select products with more active ingredient where that is possible.

Product flexibility for Septoria control, particularly for flag leaf sprays, can be summarised as follows:

Product	Curative	Protectant	Persistance
Ascra			
Librax			
Adexar			
Elatus Era			
Aviator			
Vertisan			
Keystone			
Azole			

Efficacy level key: Very good Good Moderate Poor

Note however:

a) All SDHI products will work well if timing, disease pressure and doses are appropriate.

b) There is some curative activity with all SDHI products but activity is declining.

Ear (T3): GS 59-69

For some members, the choice of ear spray will be influenced as much by the end market as by disease pressure. Those looking for milling markets will need to take a more protective view on fusarium control than those looking at feed markets.

- **Extreme/very high or high disease score or higher value end use:**

  Proline 0.55 l/ha + tebuconazole 50% dose *or* **Prosaro 1.0 l/ha**

- **Moderate disease pressure or lower fusarium risk for high value end use:**

  Proline 0.4 l/ha + tebuconazole (30-50% dose)

  or **Prosaro 0.8 l/ha** *or* **Proline 0.3 l/ha +** *either* **Amistar Opti 0.8 l/ha** *or* **Comet 0.3 l/ha**

- **Low Disease Pressure:**

  tebuconazole 50-75% dose **± Comet 0.3 l/ha**

- Note that most strobilurins are not effective against fusarium spp. or *Microdochium*. If using a mix, maintain a 'robust' azole dose if these diseases are targeted. At least a half dose azole is needed to be counted in a mycotoxin risk assessment.
- Both tebuconazole and prothioconazole products will give reasonable control of ear disease (see comments below), but the timing of the application is absolutely critical and any delay will produce very unsatisfactory results in some situations. The fungicide must be applied as the first pollen grains appear, so after GS59 (full ear emergence) and by GS65 (full flowering)
- The highest risk scenarios are rotations that contain maize, especially where the wheat crop is sown after min tillage or by strip/direct drilling after a maize crop. In this situation only high azole rates and good timing will give a satisfactory result.
- Prothioconazole-based sprays have consistently worked well in NIAB TAG trials. Robust azole doses are the main means of fusarium control in particular and should be considered for all milling (Group 1 & 2) wheats. The indications from the latest AHDB Fungicide Performance trials on fusarium in winter wheat are that Proline is likely to give a greater reduction in visual symptoms even at half dose compared to full dose of tebuconazole. However, the reduction in DON from full dose tebuconazole or metconazole is likely to be similar to high dose Proline. This suggests that Proline is controlling other ear diseases better e.g. *Microdochium*, but not so much difference on true fusarium.
- Firefly 155 (0.75 l/ha) although on limited distribution, is another prothioconazole-based T3 option.

Note: **strobilurins** have been mentioned above at three possible fungicide timings, but **no more than two** can be applied to a crop.

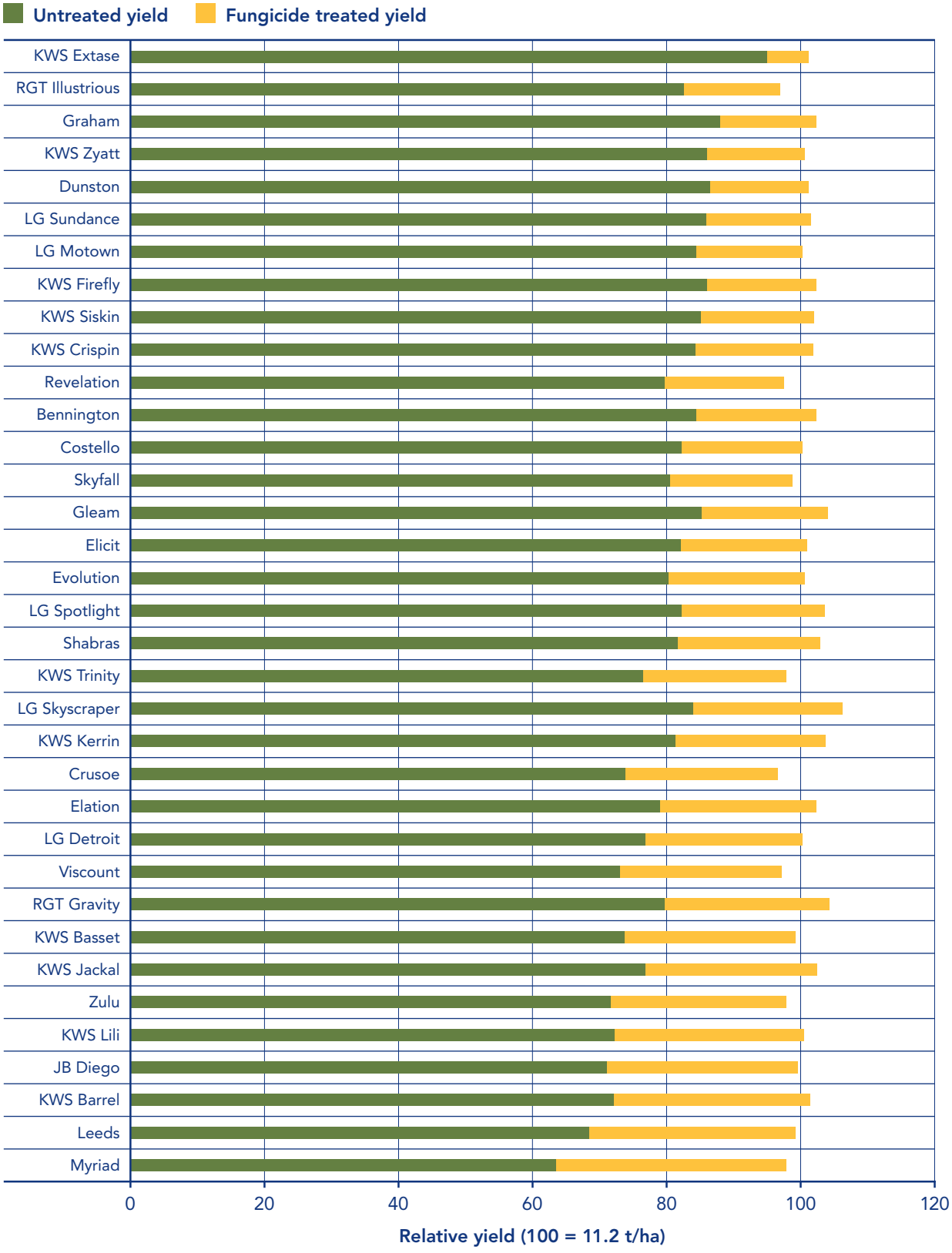
Also, only two spray applications containing **SDHIs** can be applied (but two SDHI products in one tank mix only counts as one SDHI application).

No more than two applications of a given chlorothalonil product can be applied to a crop. Different products will need to be used to cover the number of CTL applications recommended, but the total dose over the season should be kept at or below 2000 g a.i./ha.

Second ear spray (T4) – GS 69 +

In seasons when rusts, particularly brown rust, continue to threaten the crop late season, and T3 sprays were applied close to ear emergence so may not persist to crop senescence, then a further 'T4' treatment cannot be ruled out. A low dose of strobilurin/azole mix would suffice, noting latest permitted application times. A treatment at this time would only give a positive yield response IF the disease if going to significantly reduce the duration of green leaf area AND the crop is not near to the completion of grain fill. This would be too late to give any control of fusarium. Applications after the end of June are very unlikely to be cost effective.

Figure 1. Varieties listed by yield response to fungicide (AHDB RL)
Least responsive at the top



SDHI product details

Active	Products	Contains (g/l)
Fluxapyroxad	Librax	fluxapyroxad 62.5 + metconazole 45
	Adexar	fluxapyroxad 62.5 + epoxiconazole 62.5
	Imtrex	fluxapyroxad 62.5
Bixafen	Aviator	bixafen 75 + prothioconazole 160
Penthiopyrad	Vertisan	penthiopyrad 200
Isopyrazam	Keystone	isopyrazam 125 + epoxiconazole 99
	Seguris	isopyrazam 125 + epoxiconazole 90
Benzovindiflupyr (Solatenol)	Elatus Plus	benzovindiflupyr 100
	Elatus Era	benzovindiflupyr 100 + prothioconazole 150
Fluopyram	Ascra	bixafen 65 + fluopyram 65 + prothioconazole 130

Summary of programmes

All of the above is fairly technical and some members wished to have a more perscriptive programme of treatments or a suggested programme to adapt to their situations using the above. There are many different programmes that will achieve the same end result but finding one that will do so within the cost range we have suggested without compromising the dose or active ingredient choice will be important.

Very high septoria pressure e.g wet year, South West – target cost £100-£115/ha

T0 (Leaf 4) – CTL 500 g/ha (add azole e.g. tebuconazole 50% dose if active rust present, add mildewicide if required

T1 (Leaf 3) – CTL 500 g/ha + Aviator 1.0 l/ha *or* Adexar 1.0 l/ha *or* Keystone 0.8 l/ha

T1.5 (Leaf 2) – CTL 500 g/ha

T2 (Flag Leaf) – CTL 500 g/ha + Ascra 1.25 l/ha *or* Adexar 1.25 l/ha *or* Elatus Era 1.0 l/ha

T3 (Ear) – Proline 0.4 l/ha + tebuconazole 30% dose

Very high yellow rust pressure e.g. mild year, susceptible variety, East – target cost £100-£105/ha

T0 (Leaf 4) – CTL 500g/ha + azole e.g. tebuconazole 50% dose if active rust present, *or* add strobilurin if no active rust, add mildewicide if required

T1 (Leaf 3) – CTL 500g/ha + Adexar 1 l/ha *or* Keystone 0.8 l/ha

T1.5 (Leaf 2) – Azole *or* Strobilurin ± CTL

T2 (Flag Leaf) – CTL 500g/ha + Adexar 1.25 l/ha *or* Elatus Era 1.0 l/ha

T3 (Ear) – tebuconazole 75% dose

Moderate septoria pressure e.g. East – target cost £85-£100

T0 (Leaf 4) – CTL 500 g/ha (add azole e.g. tebuconazole 50% dose if active rust present, add mildewicide if required

T1 (Leaf 3) – CTL 500 g/ha + Aviator 1.0 l/ha *or* Adexar 1.0 l/ha *or* Keystone 0.8 l/ha

T2 (Flag Leaf) – CTL 500 g/ha + Ascra 1.0 l/ha *or* Adexar 1.0 l/ha *or* Elatus Era 0.8 l/ha

T3 (Ear) – Proline 275 0.4 l/ha + tebuconazole 30% dose

Low septoria pressure e.g. resistant variety in the North – target cost £60-£80/ha

No T0

T1 (Leaf 3) – CTL 500 g/ha + Proline 275 0.4 l/ha

T2 (Flag Leaf) – CTL 500 g/ha + Aviator 1.0 l/ha *or* Adexar 1.0 l/ha *or* Keystone 0.8 l/ha

T3 (Ear) – tebuconazole 75% dose

As always our updates throughout the spring will keep you informed of any changes in disease pressure.

2. Winter barley

Fungicide programmes

In light of responses to T3 fungicides and the rise in severity of late season ramularia, we continue to recommend **three-spray programmes** for winter barley. This means the T1 and T2 can be applied slightly earlier if required to better match up with PGR timings.

Prothioconazole remains the cornerstone of a barley disease control programme; however growers should look to protect this active by including alternative modes of action.

T1 (GS30-31)

This is still the more important timing due to more GAI on lower than on upper leaves. This slightly earlier timing will allow better pairing with an early growth regulator and reduce the need for a T0 treatment.

Options:

- **Siltra Xpro** **0.4-0.6 l/ha**
- **Cebara** **1.0-1.5 l/ha + Proline 0.25 l/ha**
- **Comet** **0.4 l/ha + Proline 0.3-0.4 l/ha**
- **Fandango** **0.75-1.0 l/ha**
- **Elatus Era** **0.6-0.8 l/ha**

Cyprodinil (in Cebara) will have useful activity against eyespot and mildew, also net blotch in which resistance to azoles and SDHIs is increasing.

T2 (GS37-39)

An earlier timing for the T2 will make inclusion of ethephon-based PGRs easier, in terms of application windows for these (see Strategies 3 for PGR programmes).

The justification for high doses at this timing has been difficult to prove as cost effective, the inclusion of a third spray further decreases the need for higher doses of product, in NIAB TAG trials; however brown rust susceptibility and early T2 applications may require higher doses.

All of the options below will give good control of the major barley diseases at this timing.

If mildew is actively developing, adding a morpholine (e.g. Corbel 0.3 l/ha) may exacerbate ramularia infection so should only be done under extreme mildew pressure and if possible as a separate spray.

- **Siltra Xpro** **0.4-0.6 l/ha**
- **Cebara + Proline** **0.75-1.0 l/ha + 0.33 l/ha**
- **Comet + Proline** **0.3 l/ha + 0.3-0.4 l/ha**
- **Fandango** **0.75-1.0 l/ha**
- **Priaxor** **0.75-1.0 l/ha**
- **Elatus Era** **0.4-0.6 l/ha**

In all cases add **chlorothalonil (CTL)** 500 g/ha.

T3 (GS49-59)

Only minimal input is needed here, to top up earlier treatments and provide a vehicle for a second CTL application;

Options:

- **Proline 0.25 l/ha**
- **Bumper 0.25 l/ha**
- **Fandango 0.5 l/ha***
- **Priaxor 0.75 l/ha***

In all cases add **chlorothalonil** (500 g/ha).

* Only two strobilurin applications permitted per crop

Ramularia is a significant driving factor in barley fungicide programmes now. The only reliable control option we have is chlorothalonil. There has been considerable debate as to whether it needs treating at T1: it is unlikely to be controllable at this early timing but in a traditional **two-spray programme**, with the second treatment applied at GS49 (first awns), there is likely to be a benefit to treating earlier than this. A three-spray programme allows CTL with the latter two sprays, (so no requirement at T1) but if employing a two-spray programme (or three-sprays at T0, T1 and T2) then it would be wise to include CTL at T1.

T0: in high disease pressure seasons (mild wet early spring) T0 sprays have been necessary. This has resulted in three sprays anyway so the idea of a three-spray approach is not new, though as mentioned above the earlier timings in a T1/T2/T3 programme should remove the need for separateT0 treatment.

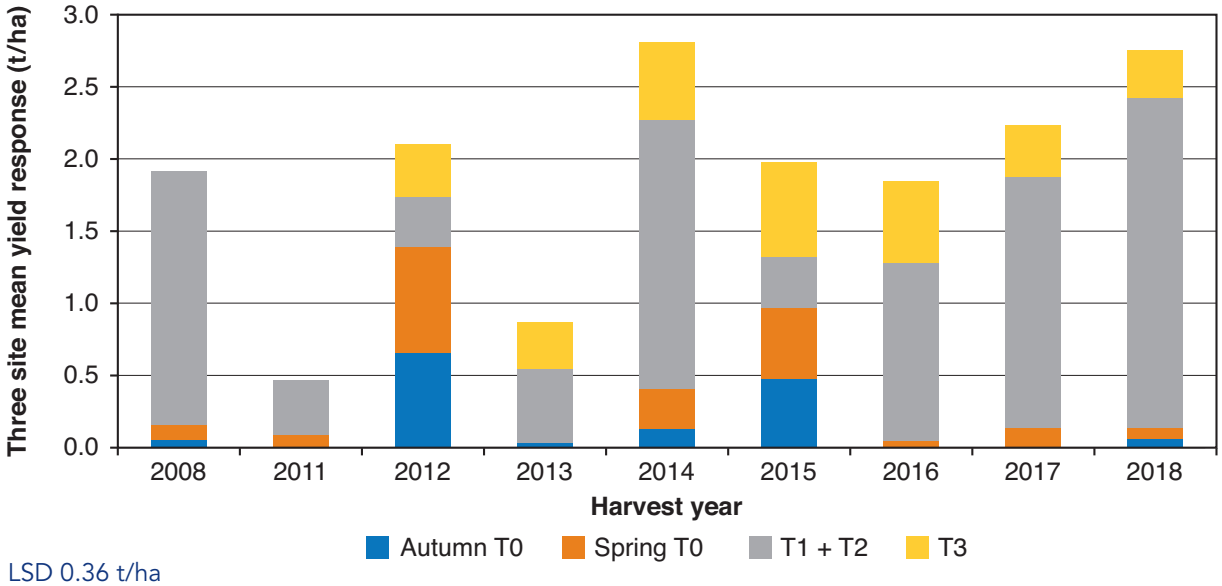
Therefore, whilst we suggest three-spray programmes as described above, a traditional two-spray approach will still give effective disease control but please note:

- T0 fungicides are more likely to be needed
- CTL should be included at T1 if the second treatment is not applied until GS49.

In all cases add a morpholine to the T0 if mildew is actively developing or if rusts are present requiring rapid knockdown (e.g. Corbel 0.3 l/ha).

Figure 2. WB18-510 – Long-term fungicide responses

9 year mean: Autumn T0 = 0.15 t/ha, Spring T0 = 0.21 t/ha, T1 + T2 = 1.16 t/ha, T3 = 0.39 t/ha



LSD 0.36 t/ha

2018 was a very low disease year but still large responses to fungicide use.

Responses to T3 treatment have been higher in the north for some time but responses are still high generally.

3. Spring barley

Fungicide programmes

1. For crops sown up to the end of March

T1 GS25 (-30) – end of tillering, before stem extension.

Siltra Xpro 0.3 (-0.4) l/ha ± chlorothalonil 500 g/ha*

The lower dose would be adequate if applied promptly when the crop is still clean. Consider up to 0.4 l/ha if disease is present on upper leaves and/or the spray is applied late.

Alternatively, specifically for a resistant variety treated promptly:

Fandango 0.8 l/ha (up to 1.2 l/ha for late treatment or developing disease)
or
Cebara 0.8 l/ha **+ Proline** 0.25 l/ha

All ± chlorothalonil (CTL) as above*

* Limited trials data to date suggest that there may be a yield response from the inclusion of CTL at T1 as well as T2.

T2 GS39-45 (flag leaf emergence – booting: maximum 25 days after T1)

Siltra Xpro 0.3 (-0.4) l/ha + CTL 500 g/ha

Alternatives:
(i) Fandango 0.5 l/ha
(ii) Proline 0.25 l/ha + **Bontima/Cebara** 0.5 l/ha
(iii) Proline 0.25 l/ha **+ Comet** 0.3 l/ha
(iv) Elatus Era 0.5 l/ha

Again, **all with CTL** as above. At this timing the CTL is **not** optional.

If the T1-T2 interval exceeds four weeks, higher doses will be needed, for example 50% increases on the doses given above.

2. For crops sown end of March to mid April

T1 GS25 (-30) – end of tillering, before stem extension.

Siltra Xpro 0.3 l/ha ± CTL 1.0 l/ha*

Alternatively, specifically for a resistant variety treated promptly:

Fandango 0.6 l/ha **± CTL 1.0 l/ha**
or
Cebara 0.6 l/ha **+ Proline** 0.2 l/ha **± CTL 1.0 l/ha**

T2 GS39-45 (flag leaf emergence – booting: maximum 25 days after T1)

Siltra Xpro 0.3 l/ha + CTL 500 g/ha

Alternatives:
(i) Fandango 0.4 l/ha
(ii) Proline 0.2 l/ha **+ Bontima/Cebara** 0.4 l/ha
(iii) Proline 0.2 l/ha **+ Comet** 0.3 l/ha
(iv) Elatus Era 0.4 l/ha

Again, **all with CTL** as above.

If the T1-T2 interval exceeds four weeks, higher doses will be needed, for example 50% increases on the doses given above.

In lower disease risk crops, **just CTL 500 g/ha** at **T1 and T2** could be considered for crops drilled end of March to mid-April. This programme has given the best margin in some trials but provides a limited spectrum of disease protection particularly for rhynchosporium and net blotch and could be a more risky option particularly in a wet late spring/summer.

3. Crops sown mid-April onwards will have a short growing season and hence should only require one treatment, however it should be one of the T1 options in (1) above, applied around GS32, plus chlorothalonil.

- Chlorothalonil is important to include at T2 to protect against ramularia, which, as with winter barley, has been the most common disease in the crop recently. Additional chlorothalonil at T1 may also show an economic yield response
- It should not be needed at T1 for ramularia control provided the T2 is expected to be timely, however if in any doubt, inclusion at T1 would be a good insurance measure.
- Responses to fungicides on spring barley are less common than in other cereals. The later the crop is sown, and hence the shorter the growing season, the less disease pressure it will experience.
- With earlier sowing the crop will experience higher disease pressure that is likely to be seen in the earlier part of spring, and coupled with the longer growing season there is a case for higher input in these crops, similar to a traditional spring barley programme as in (1) above.
- For crops sown very late (late April/early May), there will be little time for two fungicide treatments and one should suffice. However as it is the only treatment, it should involve more than just chlorothalonil, though this should be included for ramularia cover.
- **T0**: Crops sown in November, January or early February may need a fungicide at anytime before the T1 timing if conditions allow disease development in winter/early spring. This would only be a holding spray, e.g.:

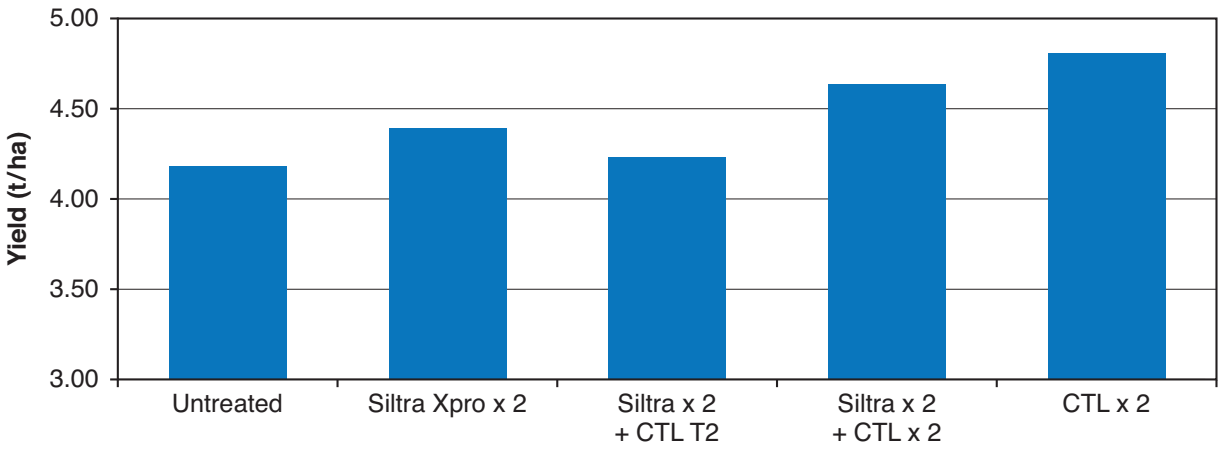
  Proline 275 0.2 l/ha (for rhynchosporium or net blotch)

  or

  Corbel 0.25 l/ha (for mildew or rust)

Figure 3. Two-spray fungicide programmes for late sown spring barley

Cirencester 2018 cv RGT Planet



LSD 0.22 t/ha. Crop sown 20 April. Only the final two treatments significantly outyielded the untreated control. However no disease was recorded at any time during the season.

4. Oats – winter and spring

Fungicide programmes

Both winter and spring oats require two-spray programmes as standard, though in areas of high crown rust pressure (e.g. the far south west) or in thick crops which develop early mildew, additional treatment at T0 cannot be ruled out.

1. Winter oats

T0: if any level of crown rust develops before the T1 timing, a low dose of triazole (e.g. tebuconazole 75 g/ha) should be considered.

T1, GS 32: for early control of crown rust and some control of mildew.

- **tebuconazole** (125 g/ha) e.g. Toledo 0.3, Folicur 0.5 l/ha.
  or
- **cyproconazole** (40 g/ha) as e.g.
  (i) Mirador Xtra (cyproconazole + azoxystrobin) 0.5 l/ha
  (ii) Cielex (MAPP no 17758) (cyproconazole + penthiopyrad) 0.66 l/ha
- If the crop is particularly susceptible to mildew such that this is the main target, add **Talius** (0.125 l/ha) *or* **Cyflamid** (0.15 l/ha).
- Kresoxim-methyl, epoxiconazole and fenpropimorph mixtures (e.g. **Mantra**) are available which, although more costly, have good rust and mildew activity (since strobilurins still control oat mildew, hence two a.i.s against this).
- If disease levels are low, this spray could be omitted provided the crop is carefully monitored between T1 and T2. Also, if subsequent disease pressure is low, a follow-up T2 treatment may not be necessary, but any one-spray approach should involve a robust product, i.e. one with more than one active ingredient.

T2, GS55-59

- Mainly for crown rust control:

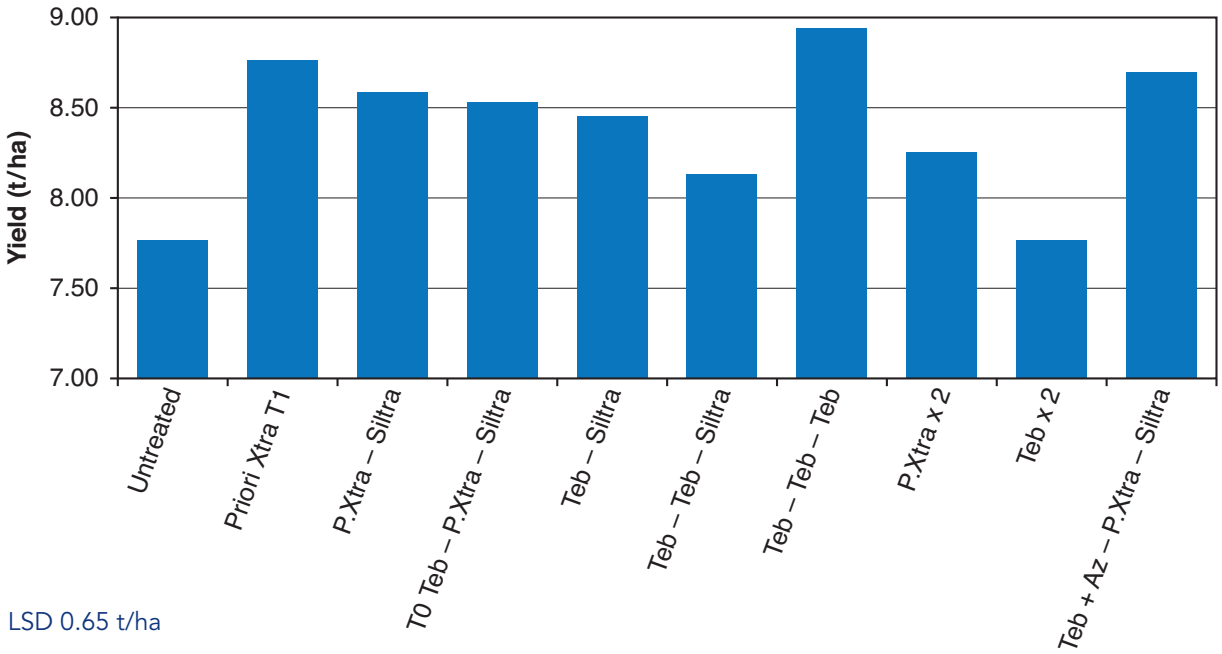
  1. **Comet 200** 0.3 l/ha plus *either* **epoxiconazole** (Cortez/Rubric 0.3 l/ha, Ignite 0.4 l/ha) *or* **prothioconazole** (e.g. Proline 275 0.4 l/ha)
  2. **Amistar** 0.25 (-0.5 l/ha) plus *either* **epoxiconazole** (Cortez/Rubric 0.3 l/ha, Ignite 0.4 l/ha) *or* **prothioconazole** (e.g. Proline 275 0.4 l/ha)
  3. **Siltra Xpro** 0.4-0.5 l/ha
  4. Alternatively **Mirador Xtra** *or* **Cielex** as above.

2. Spring oats

- Despite lower yield responses to fungicides than the winter crop, growers should budget for two-spray programmes on spring oats as above though options for a single spray in a clean year are more likely to occur.

- **Winter oats**: extra treatments (e.g. before or after T2) cannot be ruled out where rust pressure in particular is high. In the south west for example some crops need treatment to start **before the T1 timing** described above. Low doses of tebuconazole or fenpropimorph, for example, can control early rust infection until T1 arrives.
- A trial at the Newton Abbot centre in 2017 showed a reduction in rust levels where a T0 was used, but only where a low input (tebuconazole) T1 followed. With a more robust T1 (triazole plus strobilurin) there was no requirement, in terms of rust control, for a T0 treatment. In 2018, despite yields of 9.0 t/ha plus, there were no significant yield responses to any of the fungicide programmes over the untreated control.
- A similar trial at Cirencester (Glos) in 2018 produced several significant yield responses, and in many ways reflected the 2017 Devon trial. A tebuconazole-only approach performed reasonably well provided it was a three-spray programme, but with a more-robust product (Priori Xtra in this case, now available as Mirador Xtra) a single spray at GS32 gave a similar response (see Figure 4).
- **Spring oats**: occasionally drechslera leaf spot develops in spring oats. A NIAB TAG trial in 2016 showed that Bumper 250 EC (propiconazole) was effective at controlling this, along with tebuconazole, Siltra Xpro, and Proline.

Figure 4. Fungicide programmes for winter oats, Cirencester 2018 (cv Mascani)



LSD 0.65 t/ha

5. Spring wheat

Fungicide programmes

As with spring barley, the standard programme for this crop involves two sprays.

Autumn sown crops however should be treated as for winter wheat (see section 1).

If the crop is late sown (late March onwards) then a single treatment may suffice.

If a single spray is planned it should be applied at GS39-45 (T2 below).

T1 – GS31

As stated, if the crop is late sown or particularly clean at this stage this may not be needed.

- If Septoria in particular is developing, apply chlorothalonil with a low dose of triazole, e.g.

  Bravo 1.0 l/ha + **Cortez**, **Rubric** 0.3-0.5 l/ha, or + **Ignite** 0.4-0.6 l/ha

  or

  Bravo 1.0 l/ha + **Proline** 0.25-0.35 l/ha

- Although most varieties have good resistance, **mildew** can also be an issue at this timing, in which case add a low dose of morpholine for eradicant activity.

  With higher mildew pressure, for example crops which develop a dense canopy consider the more protectant and persistent products **Talius**, 0.125 l/ha, or **Cyflamid** 0.15 l/ha, alone or mixed with above treatments as required.

T2 – GS39-45

- Where disease pressure is low, repeat the T1 spray.
- If disease is present and developing, and/or the yield potential is high, consider a SDHI-based treatment, e.g.

  Adexar 0.8-1.0 + Bravo 1.0 l/ha *or* **Aviator 0.625-0.8 l/ha**

  A morpholine may again need to be added for mildew control.

T3

- Ear sprays may be necessary for quality crops where there is a risk of ear blight. (see Section 1, winter wheat) or where T2 persistence has subsided and disease pressure maintained:

  Proline 275 0.4 l/ha *or* **tebuconazole 190-250 g a.i./ha**

- **Ascra** and **Elatus Era** are approved for this crop and though we have not tested them they, along with the other SDHI products, should only be considered in situations of high yield potential and/or high disease pressure. **Vertisan** is also approved for spring wheat and could be considered as a SDHI-based T2 spray (with azole and chlorothalonil added).

6. Winter oilseed rape

Fungicide programmes

Stem extension (i.e. before green bud)

Proline 275 0.3-0.4 l/ha *or* **tebuconazole** 190-250 g a.i./ha

Use the higher doses where an autumn spray was not applied or was applied before mid-October.

Depending on light leaf spot pressure, this spray is now optional and could be omitted provided:

a) There is no evidence of light leaf spot in the crop

b) The variety has a robust resistance rating (seven or above on the recommended list) e.g. Barbados, Nikita, Elgar, Flamingo etc.). Incubating leaves to check for light leaf spot infection is, however, still strongly encouraged to be certain when making a decision.

c) The last autumn spray was applied late October or later, and was prothioconazole-based or Refinzar.

Note that label details of tebuconazole products regarding their use in oilseed rape may vary in terms of **total dose** and **number of applications** allowed. Therefore please check the details of products you plan to use, particularly if also using tebuconazole in PGR programmes.

- **Prochloraz** also has activity against light leaf spot so products such as Orius P (prochloraz plus tebuconazole) would be options for this timing.

Early-mid-flowering:

- Sclerotinia incidence was again low in 2018 compared to the high incidences of a few years ago. However this spray should still be considered routine for all crops.
- Apply

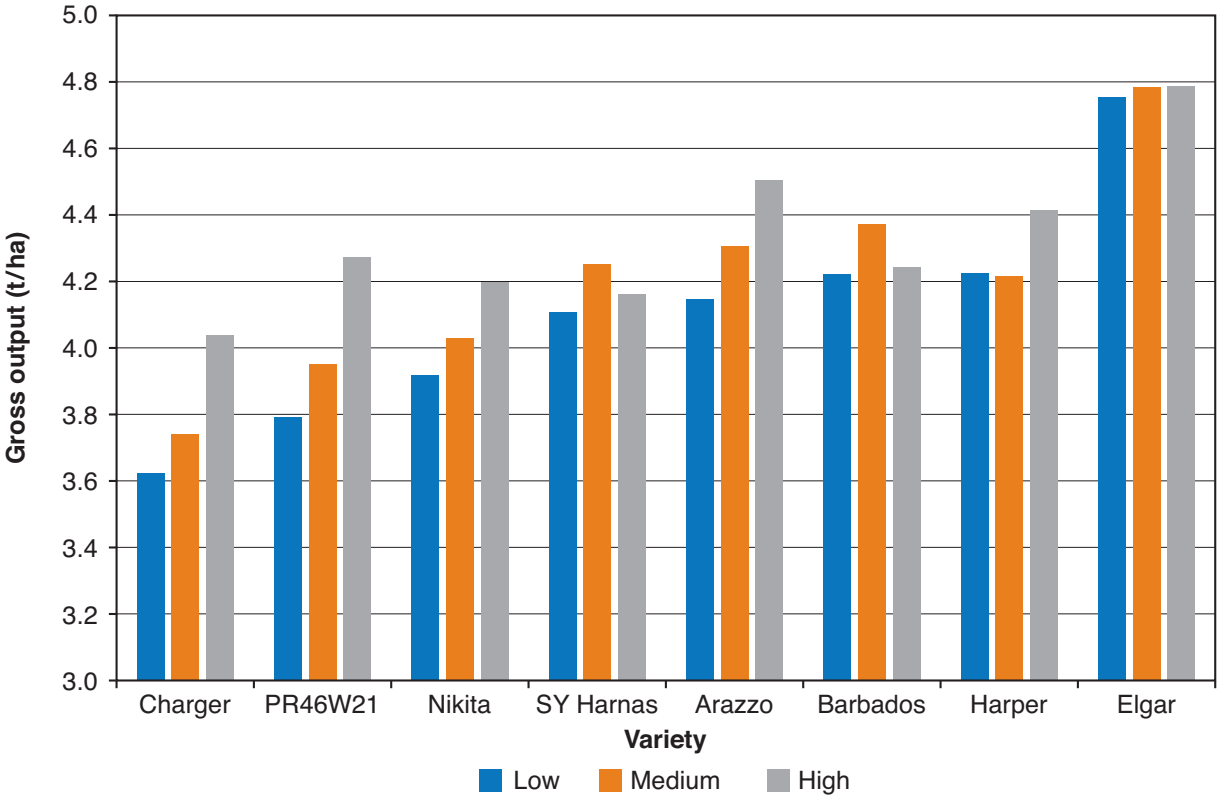
  (i) **Proline 275** 0.4-0.6 l/ha

  (Note: the maximum season-long dose of Proline 275 is 1.26 l/ha)

  Add *either* **Amistar** 0.5-0.7 l/ha *or* **Filan** 0.25 kg/ha for higher disease risk. The lower doses in the ranges given would be a good insurance option where the disease risk is not high, where the crop is backward hence lower yield potential, or where two sprays are planned (see below).

  (ii) **Taurus** (thiophanate-methyl) 0.5 kg/ha + **tebuconazole** 190-250 g/ha – for lower risk crops, though this is more likely to require a follow-up (e.g. Proline 275) later.
- **Timing**: aim to apply a single spray around mid-flower.
- **Alternaria**: this is still an occasional problem in the wetter west of the UK and would likely require a two-spray approach for both diseases as it tends to develop later in the flowering phase than sclerotinia.
- **Verticillium**: as yet there is still no evidence of chemical control options for this disease.

Figure 5. Three-site mean data for gross output from eight varieties of oilseed rape, grown under three fungicide regimes



The graph above shows the results from a member trial (WOR18-9121) the purpose of which was to assess the economic efficacy of three levels of fungicide input in controlling disease and enhancing gross output, on a set of varieties of oilseed rape, selected for having a range of resistance to the two principal diseases, phoma stem canker and light leaf spot. This trial was run at Aby, Hereford and Sutton Scotney to provide a range of weather patterns and disease pressure.

There were large variety x fungicide programme interactions and, in general, the more stem canker-susceptible varieties showed cost effective responses to fungicide inputs. In the case of the most susceptible varieties, Charger and PR46W21, the high input T3 programmes gave the best results.

Fungicide applications, on the more disease-resistant varieties, were not cost-effective. The result from this trial reinforces the strategy above and strongly suggests that the stem extension spray can be omitted on varieties with a resistance rating of seven and above, seasonal conditions and disease pressure permitting. Incubating leaves to check for infection is a useful task to give confidence when taking this approach.

The table below shows the results from the trial as a three-site mean for each variety. Differences in income according to the different programmes can be picked out from this table and the differences in varietal resistance to light leaf spot are clear.

Table 1. Three-site mean data for gross output, income adjusted for the cost of fungicide inputs and differential value of the different programmes, for eight varieties of oilseed rape, grown under three fungicide regimes and at three locations

	Gross output (t/ha) (adjusted for oil content)			Income (£0)*			Income difference (£)		
	F1	F2	F3	F1	F2	F3	F2-F1	F3-F1	F3-F2
Elgar	4.76	4.78	4.79	1495	1469	1421	-25.97	-73.93	-47.96
Harper	4.22	4.22	4.41	1325	1287	1302	-37.81	-23.05	14.76
Barbados	4.22	4.38	4.24	1324	1338	1247	14.03	-76.81	-90.84
Arazzo	4.15	4.31	4.50	1299	1316	1330	16.59	31.03	14.44
SY Harnas	4.10	4.25	4.16	1286	1299	1221	12.75	-65.29	-78.04
Nikita	3.92	4.03	4.20	1228	1226	1233	-1.33	5.43	6.76
PR46W21	3.80	3.95	4.28	1187	1202	1258	14.67	70.39	55.72
Charger	3.62	3.75	4.04	1133	1136	1183	3.79	49.91	46.12
MEAN	4.10	4.21	4.33	1285	1284	1274	-0.41	-10.25	-9.88

* Income is crop value adjusted down by the cost of fungicide programmes/ha

F1 = £27.00; F2 = £62.25; F3 = £110.85

- **Stem extension sprays**: Light leaf spot is the main target of this spray timing. Phoma leaf spot is not worth treating at this time.
- Some **PGR sprays** also have fungicide activity (Caryx and Toprex are specific PGR products but also contain azole fungicides) but high triazole doses (as required for PGR effect) have tended to reduce yield on low-GAI crops or those on light land, so be careful with triazole dose if treating light leaf spot at the late stem extension timing.
- Late-developing crops may, however, be under stress or just struggling to grow and develop and these may suffer adverse effects from a triazole fungicide application. If in any doubt delay such a spray until the crop is clearly 'recovering'.
- **Flowering sprays**: although some crops suffered sclerotinia infection in 2018, overall the incidence is still relatively low and it is difficult to justify a routine two-spray approach at flowering. However if flowering is prolonged (more than four weeks) and a second spray considered, Taurus/Topsin would also be good options for this.
    - Note also that in high sclerotinia pressure seasons, flowering sprays can give large yield responses and hence large financial returns.
    - Boscalid (in Filan) should be in mixture with another active if used as a flowering spray.
    - Late developing crops with low apparent yield potential and showing uneven development within the crop may still unfortunately be candidates for two sprays if their flowering period is prolonged due to late and hence staggered flowering among individual plants.

- **Propulse**, **Skyway** (both bixafen-based products) and Symetra (isopyrazam plus azoxystrobin) are all SDHI-based products for the flowering timing. We have not been able to evaluate them in a high disease pressure season but they would be options for the main early-mid flower treatment.
- **Average daily air temperature and disease risk**: the timing of sclerotinia infection and hence treatments can be assessed by recording daily air temperatures. The rolling average daily air temperature is calculated as the mean of the maximum and minimum air temperature for each day, averaged over the past seven days, and this figure adjusted daily into the new seven-day average. When this figure is consistently above 11°C, then conditions become suitable for infection to start. Experience in dry seasons suggests that whilst rainfall during periods of elevated temperature increase the risk, it is possible for significant disease to develop in dry conditions (e.g. 2007).
- **Verticillium** continues to be commonly-found in crops late season but symptoms are difficult to differentiate from early senescence caused by sclerotinia. Verticillium wilt/stem rot is caused by a soil-borne fungus. The first symptoms of infection are pale or bronzed leaves around the flowering stage. Some root damage is likely, allowing plants to be pulled up easily, and later the stem dies off prematurely, giving a stem rot similar to that of sclerotinia. Verticillium also produces black sclerotia inside the stem, but these are much smaller than those of sclerotinia, and have been likened to a dusting of iron filings.

  There is little or no evidence to date that the disease can be even partly controlled by fungicides.

7. Field beans

Fungicide programmes

Winter Beans

Pre-flowering: in a wet spring early aggressive chocolate spot may dictate treatment before the standard T1 timing. If so **tebuconazole** 125 g a.i./ha (e.g. Toledo 0.3 l/ha, Folicur 0.5 l/ha) should be considered.

- **Early to mid-flowering (T1)**

  Targeting chocolate spot and, in exceptionally warm springs, rust:

  i) **Tebuconazole** (125-190 g/ha) e.g. Folicur, Toledo, Orius + **Rover*** 1.0 l/ha

  or

  (ii) **Chlorothalonil + cyproconazole** (Alto Elite, Octolan, Baritone, all at 1.0-1.5 l/ha)

  or

  (iii) **Signum** 0.5 kg/ha

- **Mid-late flower (T2). 3-4 weeks after T1**

  Targeting chocolate spot and rust:

  (i) **Rover*** 1.0 l/ha + *either* **tebuconazole** as above *or* **Amistar** 0.5 l/ha

  or

  (ii) **Alto Elite/Octolan** etc, as above, 2.0 l/ha;

  add **Amistar** 0.5 l/ha if disease pressure is particularly high and rust is a particular target.

  or

  (iii) **Signum** 0.5 kg/ha

* Rover is the only straight chlorothalonil product approved for field beans, but feed crops only. If available it would provide a low cost option, mixed with either tebuconazole or azoxystrobin as described above (and see trial results below).

Downy Mildew. If downy mildew threatens, be prepared move the above timings forward, as most treatments suggested will give some protection if applied at the first signs of disease.

However if the disease is well-established then metalaxyl will be required. **SL 567A** (with EAMU) is the only option here, at 3/4 dose minimum – the full dose for beans on the EAMU is **160 ml/ha**.

Spraying should commence once 20% of plants have symptoms.

Dry sunny weather gives effective control, but if cool damp conditions persist then treatment will be needed as described.

Spring Beans

In many cases a single spray is sufficient for the spring crop:

- **Mid-flowering (T1)**

  Targeting chocolate spot and rust. Earlier timing may be required in which case a two spray programme is likely.

  (i) Chlorothalonil + cyproconazole (Alto Elite, Octolan, Baritone, all at 1.0-1.5 l/ha)

  Add **Amistar** 0.5 l/ha if disease pressure is particularly high or there is a likelihood of a second spray not being required.

  or

  (ii) Rover 1.0 l/ha + **tebuconazole** (125-180 g/ha)*

  or

  (iii) Signum 0.5 kg/ha

- **Optional – mid-late flower (T2). 3-4 weeks after T1**

  Targeting chocolate spot and rust may or may not be necessary depending on the timing of the first spray and disease pressure:

  (i) Alto Elite etc (as above) 1.0 l/ha *or* **chlorothalonil** (**Rover***) + **tebuconazole** (as above)

  add **Amistar** 0.5 l/ha if disease pressure is particularly high

  or

  (ii) Signum 0.5 kg/ha

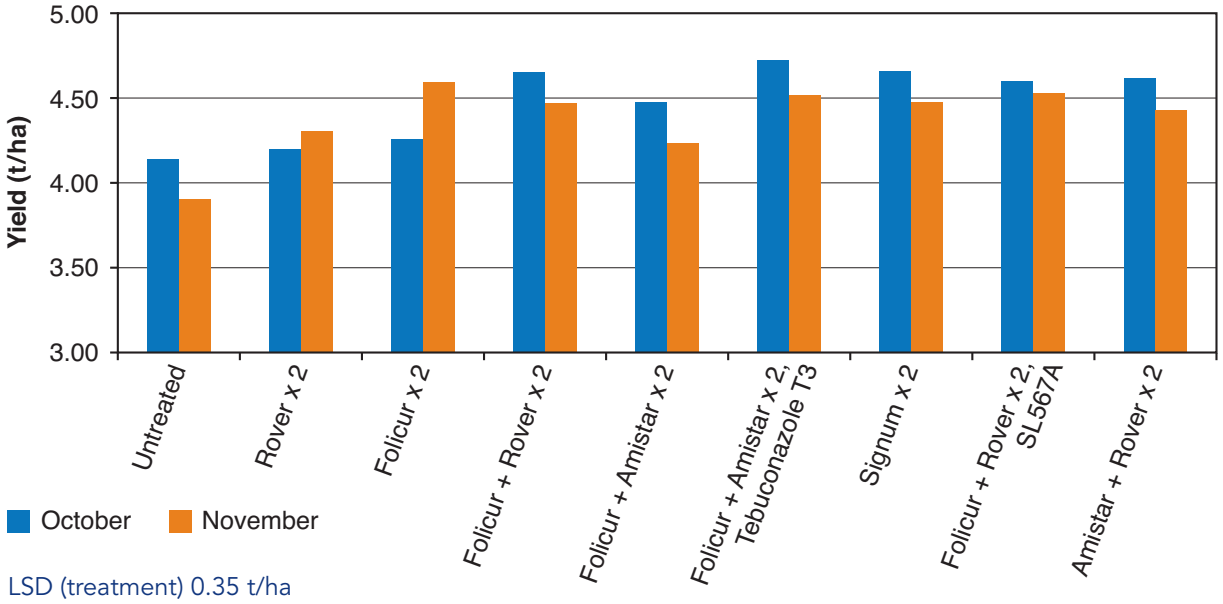
* As with the winter crop, Rover is the only straight chlorothalonil product approved for beans, but feed crops only. More spring beans than winter will go for human consumption and this may not be a treatment option for these crops.

- The main disease threats in **winter beans** are chocolate spot at T1 and chocolate spot and rust at T2, though with high disease pressure both diseases can be problems at both timings.
- Treatment before flowering has rarely been worthwhile, though severe frost or wind damage can pre-dispose the crop to early aggressive chocolate spot in winter crops.
- Disease levels in **spring beans** can be low, often requiring a single treatment but a wet spring/summer may dictate two-spray programmes as discussed above.
- **Rust** is now a threat to both winter as well as spring beans, particularly in warm early springs.
- **Downy mildew: SL 567A**: the full dose in the EAMU (160 ml/ha) gives a similar dose of metalaxyl as in previously-approved metalaxyl products. Even at this low dose it is still a significant cost so a good yield response, from controlling a significant infection, is required to make it cost-effective.
- **Timing**: downy mildew may appear well before the first planned spray timing, so monitor crops at any time when cool damp conditions persist.

Below are data from winter bean fungicide trials in 2017, with a comment on the 2018 trial.

Figure 6. Winter bean fungicide programmes, cv Tundra, two sowing dates

Mean of results from Hereford and Cambridge 2017

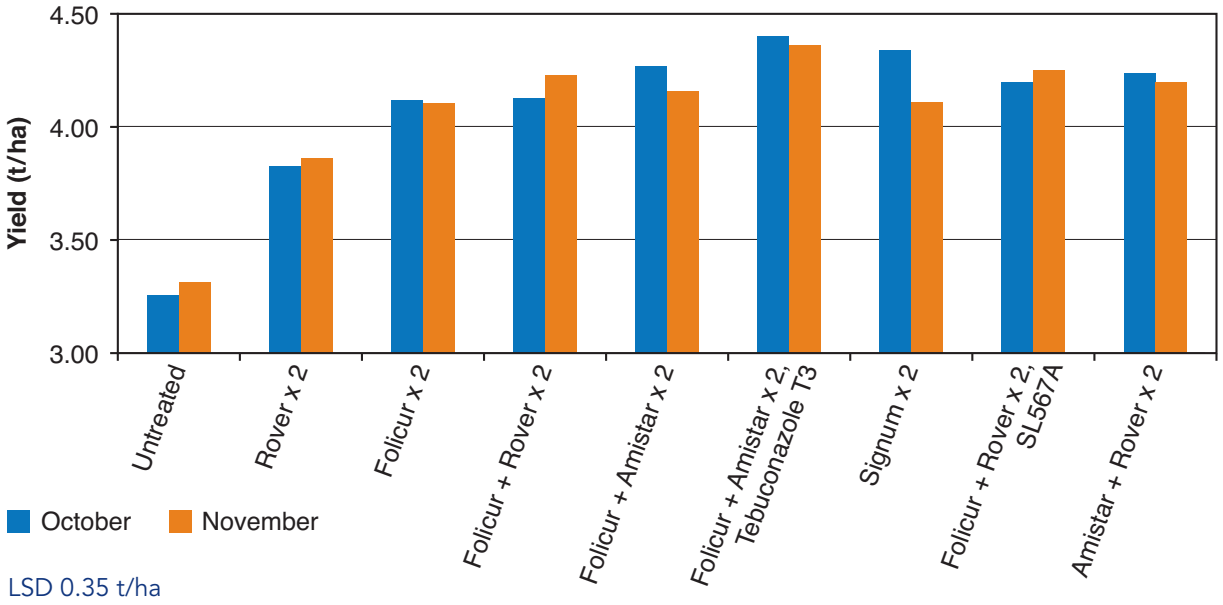


LSD (treatment) 0.35 t/ha

For most of the treatments higher yields were seen in the earlier sown crop but response over the untreated control was similar for both sowings. The CTL-only programme did not perform well but for the early sowing there was no significant response to input above two sprays of tebuconazole plus CTL, and for the later sowing no response above two tebuconazole sprays.

Figure 7. Winter bean fungicide programmes, cv Bumble, two sowing dates

Mean of results from Hereford and Cambridge 2017



LSD 0.35 t/ha

Bumble gave larger responses to fungicides but, compared to Tundra, showed little difference in response between the two sowing dates. General higher responses were seen with programmes above the low input tebuconazole/CTL approach.

Full details of this trial can be found in the *Members Trial Results 2016/17* book, p.238.

The same trial in 2018 showed much lower yield responses. At Cambridge the tebuconazole + CTL programme gave one of the highest yields though overall responses were not significant, and at Hereford yield responses were even smaller with no significant response over the untreated. This underlines the need to avoid excessive expenditure in this crop and treatments based on tebuconazole and chlorothalonil would be appropriate in this respect.

More details on the 2018 trial can be found in the *Members Trial Results 2017/18* book, p.236.

8. Spring peas

Fungicide programmes

1. **Pod set: cyproconazole + chlorothalonil** (e.g. **Alto Elite/Octolan/Baritone 1.0-1.5 l/ha**)

   This fungicide gives broad spectrum control of pea diseases and in the majority of cases no further sprays will be needed. The exact dose may be linked to density of canopy or whether earlier treatment was applied (see below).

Optional two-spray programmes:

2. **Pre-pod set** followed by **pod set** (as above): if the crop lodges disease pressure will increase so thick crops on lodging-prone, fertile soils or varieties with poor standing power will need higher input. An additional early- to mid-flower treatment, products/doses as above, should be applied (i.e. **prior to the pod set spray**).

   Note that the later spray (1) is routine, and the earlier spray (2) is optional depending on likely disease pressure. The key is to apply a fungicide before the crop lodges, if this is likely. If not, a single post flower spray will be sufficient.

3. **Pod set** (as above) **followed by late pod set** In exceptional circumstances such as continual wet weather or very dense crop canopies then a second pod set spray may be needed. Consider:

   Amistar 0.5 l/ha *or* **Alto Elite/Octolan/Baritone** 1.0 l/ha, 2-3 weeks after the pod set spray.

- **Chlorothalonil** is an important element in pea disease control. The **cyproconazole** component in the products mentioned is particularly effective against powdery mildew.

- Botrytis (grey mould) and mycosphaerella (leaf and pod spot) are the two main diseases of peas. Grey mould is firstly attracted to the wet flowering petals which subsequently become detached from the plant and become lodged on the leaf axils where infection can cause stem or pod rots, affecting both yield and quality. Hence the main spray is applied at pod set i.e. petal fall.

- In years where there is a prolonged period of flowering or high disease pressure a second spray can be required.

- As with beans, leaf or pod spot (aschochyta) can occur following periods of prolonged wet weather and is a seed-borne infection best controlled by good seed hygiene.

9. Spring oilseeds

1. Spring linseed

All crops of spring linseed should receive routine fungicide treatment during flowering. In seed crops this will help to safeguard seed quality, in other crops it would be an insurance against late infection sufficiently severe to have a negative impact on yield.

In many trials, yield responses reflect weather conditions at flowering; in dry years no benefit from fungicide treatments was seen, whilst in wetter years **tebuconazole** applied late flowering/pod set gave good responses and would be one of the more cost-effective options.

Winter linseed

Unlike the spring crop, responses to fungicides in winter linseed have been fairly consistent. Applied at pod set, yield responses of 0.4-0.6 t/ha have been achieved. A routine spray at this timing (i.e. any of the products listed below) would be beneficial.

Approved fungicides: tebuconazole (some products)

Approved under EAMUs: Juventus/Sunorg Pro, Filan, Proline 275, some prochloraz products.

2. Spring oilseed rape – no fungicides required

In NIAB TAG trials over several years this crop has not responded to fungicides. Occasionally disease has been found in trials but any yield response to fungicide application has not been cost-effective.

In the years of severe sclerotinia in the winter crop this disease was later seen in the spring crop, so if the pressure from this disease is high for winter rape, there should be time to decide whether a treatment is warranted on the spring crop. If in doubt the cost can be held by using products such as Topsin/Taurus (thiophanate-methyl) or tebuconazole.

Appendix

Fungicide products and active ingredients

Listed below are the active ingredient levels of the products listed in these Strategies, together with a **non-exhaustive** list of alternative products with the same active ingredient(s), which may be offered when purchasing.

For further detailed information about all products and to allow easy comparison between similar products, please see **ActivSmart** on **www.niabnetwork.com**. For further information on ActivSmart contact Andrew Watson on activsmart@niab.com or 07768 143730.

Active ingredient	Product	Components	On-label approval
SDHI			
1. Bixafen	Aviator 235 Xpro	bixafen 75 g/l + prothioconazole 160 g/l	winter and spring wheat, triticale and winter rye.
	Ascra Xpro	bixafen 65 g/l + fluopyram 65 g/l + prothioconazole 130 g/l	wheat
	Boogie Xpro	bixafen 50 g/l + prothioconazole 100 g/l + spiroxamine 250 g/l	winter and spring wheat, triticale and winter rye
	Inception Xpro	bixafen 125 g/l	barley
	Saltri	bixafen 60 g/l + prothioconazole 200 g/l	barley and oats
	Siltra Xpro	bixafen 60 g/l + prothioconazole 200 g/l	barley and oats
	Skyway 285 Xpro	bixafen 75 g/l + prothioconazole 110 g/l + tebuconazole 100 g/l	winter oilseed rape, wheat, triticale and winter rye
	Sparticus Xpro	bixafen 75g/l + prothioconazole 110 g/l + tebuconazole 90 g/l	winter oilseed rape, wheat, triticale and winter rye
	Variano Xpro	bixafen 40 g/l + prothioconazole 100 g/l + fluoxastrobin 50 g/l	winter and spring wheat, triticale and winter rye
2. Benzovindiflupyr (Solatenol)	Elatus Era	benzovindiflupyr 75 g/l + prothioconazole 150 g/l	winter and spring barley, winter and spring wheat, rye, triticale
	Ceratavo Plus*	benzovindiflupyr 100 g/l	winter and spring barley, winter and spring wheat, rye, triticale
	Elate	benzovindiflupyr 75 g/l + prothioconazole 150 g/l	winter and spring barley, winter and spring wheat, rye, triticale
	Elatus Plus*	benzovindiflupyr 100 g/l	winter and spring barley, winter and spring wheat, rye, triticale
	Velogy Plus*	benzovindiflupyr 100 g/l	winter and spring barley, winter and spring wheat, rye, triticale

* Only supplied with other active(s) as part of twin-pack

Active ingredient	Product	Components	On-label approval
SDHI			
3. Fluxapyroxad	Adexar	fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Apex Pro	fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Bugle	fluxapyroxad 59.4 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Ceriax	fluxapyroxad 41.6 g/l + epoxiconazole 41.6 g/l + pyraclostrobin 66.6 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Chusan	fluxapyroxad 41.6 g/l + epoxiconazole 41.6 g/l + pyraclostrobin 66.6 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Clayton Index	fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Clayton Tardis	fluxapyroxad 62.5 g/l + metconazole 45 g/l	wheat, durum wheat, barley, triticale and rye
	Cougar	fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Divexo	fluxapyroxad 37.5 g/l and chlorothalonil 375 g/l	wheat, durum wheat, barley
	Flux	fluxapyroxad 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Imtrex	fluxapyroxad 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Librax	fluxapyroxad 62.5 g/l + metconazole 45 g/l	wheat, durum wheat, barley, triticale, rye
	Morex	fluxapyroxad 59.4 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Pexan	fluxapyroxad 59.4 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Priaxor	fluxapyroxad 75 g/l + pyraclostrobin 150 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Serpent	fluxapyroxad 75 g/l + pyraclostrobin 150 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Smaragdin	fluxapyroxad 41.6 g/l + epoxiconazole 41.6 g/l + pyraclostrobin 66 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Standon Coolie	fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Syrex	fluxapyroxad 75 g/l + pyraclostrobin 150 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Vortex	fluxapyroxad 41.6 g/l + epoxiconazole 41.6 g/l + pyraclostrobin 61 g/l	wheat, durum wheat, barley, triticale, rye and oats
	Wolverine	fluxapyroxad 62.5 g/l + metconazole 45 g/l	wheat, durum wheat, barley, triticale, rye
	Zoro	fluxapyroxad 59.4 g/l + epoxiconazole 62.5 g/l	wheat, durum wheat, barley, triticale, rye and oats

Active ingredient	Product	Components	On-label approval
SDHI			
4. Isopyrazam	Bontima	isopyrazam 62.5 g/l + cyprodinil 187.5 g/l	winter and spring barley
	Cebara	isopyrazam 62.5 g/l + cyprodinil 187.5 g/l	winter and spring barley
	Clayton Kudos	isopyrazam 125 g/l + epoxiconazole 90 g/l	winter wheat, winter and spring barley, rye and triticale
	Concorde	isopyrazam 62.5 g/l + cyprodinil 150 g/l	winter and spring barley
	Keystone	isopyrazam 125 g/l + epoxiconazole 99 g/l	winter wheat, winter and spring barley, rye and triticale
	Micaraz	isopyrazam 125 g/l + epoxiconazole 90 g/l	winter wheat, winter and spring barley, rye and triticale.
	Prizm	isopyrazam 125 g/l + prothioconazole 150 g/l	wheat, barley, rye, triticale
	Seguris	isopyrazam 125 g/l + epoxiconazole 90 g/l	winter wheat, winter and spring barley, rye and triticale.
	Symetra	isopyrazam 125 g/l + azoxystrobin 200 g/l	oilseed rape
	Zulu	isopyrazam 125 g/l	winter and spring barley
5. Penthiopyrad	Aylora	penthiopyrad 100 g/l + chlorothalonil 252 g/l	barley, wheat
	Cielex (16540)	penthiopyrad 150 g/l + cyproconazole 60 g/l	wheat
	Cielex (17758)	penthiopyrad 150 g/l + cyproconazole 60 g/l	oats
	Intellis	penthiopyrad 200 g/l	wheat, barley, oats, rye, triticale
	Intellis Plus	penthiopyrad 100 g/l + chlorothalonil 252 g/l	barley, wheat
	Sentenza	penthiopyrad 200 g/l	wheat, barley, oats, rye, triticale
	Treoris	penthiopyrad 100 g/l + chlorothalonil 252 g/l	barley, wheat
	Trust	penthiopyrad 100 g/l + chlorothalonil 252 g/l	barley, wheat
	Vertisan	penthiopyrad 200 g/l	winter and spring wheat, winter and spring barley, oats, rye, triticale

Active ingredient	Product	Components	On-label approval
SDHI			
6. Boscalid	Bonafide	50% w/w boscalid	oilseed rape
	Chord	boscalid 210 g/l + epoxiconazole 75 g/l	barley, durum wheat, oats, rye, triticale, wheat
	Coli	50% w/w boscalid	oilseed rape
	Enterprise	boscalid 140 g/l + epoxiconazole 50 g/l	barley, oats, rye, triticale, wheat
	Filan	50% w/w boscalid	oilseed rape
	Fulmar	50% w/w boscalid	oilseed rape
	Highgate	boscalid 133 g/l + metconazole 60 g/l	oilseed rape
	Insignis	boscalid 26.7 % w/w + pyraclostrobin 6.7% w/w	field beans, combining peas and vining peas
	Kingdom	boscalid 140 g/l + epoxiconazole 50 g/l	barley, oats, rye, triticale, wheat
	Nebula XL	boscalid 140 g/l + epoxiconazole 50 g/l + pyraclostrobin 60 g/l	barley, oats, rye, triticale, wheat
	Pictor	boscalid 200 g/l + dimoxystrobin 200 g/l	winter oilseed rape
	Signum	boscalid 26.7 % w/w + pyraclostrobin 6.7% w/w	field beans, combining peas and vining peas
	Tectura	boscalid 133 g/l + metconazole 60 g/l	oilseed rape
	Tracker	boscalid 233 g/l + epoxiconazole 67 g/l	barley, durum wheat, oats, rye, triticale, wheat
	Whistle	boscalid 210 g/l + epoxiconazole 75 g/l	barley, durum wheat, oats, rye, triticale, wheat

	Active ingredient	Example products
Azole	epoxiconazole	Opus, Bowman, Cortez, Rubric, Epic, Corral, Amber (all 125 g/l) Ignite (83 g/l)
	tebuconazole	Orius, Fathom, Deacon, Erase, Mitre (all 200g/l), Standon Beamer, Odin, Folicur (all 250 g/l), Toledo (430 g/l)
	metconazole	Caramba 90, Sunorg Pro, Juventus, Metal (all 90 g/l), Gringo, Caramba, Metal 60 (all 60 g/l)
	prothioconazole	Proline 275 (275 g/l), Banguy, Prothio, Decoy 250 (all 250 g/l)
	propiconazole	Bumper, Bounty, Anode, Matsuri (all 250 g/l)
Morpholine	fenpropimorph	Corbel, Crebol, Clayton Spigot (all 750 g/l)
Multi-site	chlorothalonil	Bravo 500, Asterix, Joules, Damocles, Piper, Rover 500, Supreme (all 500 g/l)
	folpet	Arizona, Phoenix (both 500 g/l)

- **Please check** if using an alternative product that it is approved for the crop concerned. Different products with identical formulations do not always have the same approved crops list. This is particularly pertinent to EAMUs.
- Note EAMUs are not listed here, all above are full label approvals.
- Inclusion of an alternative product in this list does not represent an endorsement of that product, nor does it imply that products not included in the list are inferior.
- Please check also for levels of active ingredients. Although some of the differences have been highlighted where appropriate, members should still check a.i. levels as differences could clearly lead to different levels of efficacy if used at the same rates recommended in the particular Strategy.

NIAB

1919-2019 100 YEARS OF PLANT SCIENCE

NIAB is a leading UK centre for plant science, crop evaluation and agronomy, with headquarters in Cambridge and regional offices across the country. NIAB spans the crop development pipeline, combining within a single resource the specialist knowledge, skills and facilities required to support the improvement of agricultural and horticultural crop varieties, to evaluate their performance and quality, and to ensure these advances are transferred into on-farm practice through efficient agronomy.

With an internationally recognised reputation for independence, innovation and integrity, NIAB is ideally placed to meet the industry's current and future research, information and knowledge transfer needs.

We conduct field crops research and provide impartial variety and crop husbandry information. Our knowledge base is drawn from extensive staff expertise, research data and field trials from ten regional centres across the UK.

For more information log onto www.niab.com

To enquire about NIAB membership services, contact:

NIAB
Huntingdon Road
Cambridge CB3 0LE
Tel: +44 (0)1223 342200
Fax: +44 (0)1223 277602
info@niab.com